Atmospheric Environment Vol. 16, No. 4, pp. 765–773, 1982
Printed in Great Britain.

0004-6981/82/040765-09 $03.00/0

A COMPARISON OF SHORT-TERM DISPERSION ESTIMATES RESULTING FROM VARIOUS ATMOSPHERIC STABILITY CLASSIFICATION METHODS

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(*First received* 10 *October* 1980 *and in final form* 18 *May* 1981)

Abstract—Four methods of classifying atmospheric stability class are applied at four sites to make short-term (1-h) dispersion estimates from a ground-level source based on a model consistent with U.S. Nuclear Regulatory Commission practice. The classification methods include vertical temperature gradient, standard deviation of horizontal wind direction fluctuations (sigma theta), Pasquill–Turner, and modified sigma theta which accounts for meander. Results indicate that modified sigma theta yields reasonable dispersion estimates compared to those produced using methods of vertical temperature gradient and Pasquill–Turner, and can be considered as a potential economic alternative in establishing onsite monitoring programs.

1. INTRODUCTION

This is a report on an extension of earlier work involving the use of the modified sigma theta (MST) atmospheric stability classification scheme introduced by Mitchell and Timbre (1979). The methods was developed for application at locations where low-cost ambient monitoring systems were employed to gather site-specific data. The MST method and three commonly used methods were applied to meterological data sets at sites of differing typical terrains. Subsequently, data sets for four typical sites were classified by four stability classification methods (Mitchell and Timbre, 1980). In turn, the data sets were used to estimate annual average dispersion concentrations from a ground-level source, and the MST method yielded reasonable results to warrant its use.

In this study, the application of the methods to make short-term dispersion estimates is addressed. The four stability classification methods are reviewed and applied to the same data sets as those used in the annual-average study. The stability frequency distributions along with wind speed and direction data are used in an atmospheric dispersion model to determine short-term (1-h, accident) dispersion estimates.

2. STABILITY CLASSIFICATION METHODS

Dispersion models for common regulatory agency practice, U.S. Environmental Protection Agency (USEPA), and U.S. Nuclear Regulatory Commission (USNRC) usually permit the use of only a single descriptor of atmospheric stability rather than a descriptor for each of the vertical and horizontal components of dispersion. In addition, the models usually require a class descriptor of stability rather than a continuous descriptor. Although future "off-the-shelf" dispersion models are expected to use continuous descriptors of both the vertical and horizontal components of atmospheric stability, in this study only the class descriptor is considered.

The four methods for classifying stability considered in this study and the conventions used to refer to each are as follows:

DT/DZ—Vertical Temperature Gradient
SIGMA—Sigma Theta
NWS-PT—U.S. National Weather Service Pasquill–Turner
MST—Modified Sigma Theta.

Stability classes ranged from A (extremely unstable) to D (neutral) to G (extremely stable).

(a) *DT/DZ*. For this method, the temperature gradient is typically measured over a vertical separation of 50 m with the lower-level temperature at an elevation of 10 m (USNRC, 1972). Increases in temperature with height (inversions) are associated with poor vertical mixing (stable conditions). This method is currently the most frequently used for estimating dispersion at nuclear power plant sites in the United States.

(b) *SIGMA*. This method involves the measurement of the standard deviation (sigma theta) of the horizontal wind fluctuations (USNRC, 1972). Small standard deviations are associated with stable atmospheric conditions. Sigma theta is usually measured at 10 m over the averaging time of interest (usually 1 h) but not less than 10 min. For most dispersion calculations, these measurements can well represent dispersion in the horizontal, including the components of diffusion, meander and mechanical turbulence (Hanna *et al.*, 1979). As a result, it is widely recognized that sigma theta measurements for periods of the order of 15–60 min in duration will frequently yield large values under night-time stable conditions, particularly during low wind speeds.

Table 1. Modified sigma theta (MST) method to determine atmospheric stability class (Mitchell and Timbre, 1979)

Sigma theta (degrees)	Daytime stability class†	Wind speed ($m\,s^{-1}$)	Night-time* stability class‡
Sigma $\geq$ 22.5	A	$u < 2.4$	G
		$2.4 \leq u < 2.9$	F
		$2.9 \leq u < 3.6$	E
		$3.6 \leq u$	D
22.5 > Sigma $\geq$ 17.5	B	$u < 2.4$	F
		$2.4 \leq u < 3.0$	E
		$3.0 \leq u$	D
17.5 > Sigma $\geq$ 12.5	C	$u < 2.4$	E
		$2.4 \leq u$	D
12.5 > Sigma $\geq$ 7.5	D	all wind speeds	D
7.5 > Sigma $\geq$ 3.8	E	all wind speeds	E
3.8 > Sigma $\geq$ 2.1	F	all wind speeds	F
2.1 > Sigma	G	all wind speeds	G

* Night-time is defined as the period from 1 h before sunset to 1 h after sunrise.
† More applicable to describing horizontal dispersion parameter, sigma y, at night.
‡ More applicable to describing vertical dispersion parameter, sigma z, at night.

(c) *NWS-PT*. This method makes use of observations of wind speed, cloud cover, and the time of day to classify stability. The method, based upon the work of Pasquill (1961), is the result of an objective approach by Turner (1964). Utilized in the STAR program (Martin and Tikvart, 1968), the NWS-PT method is conveniently applied to United States National Weather Service and airport meteorological data. Frequently the application of this method to historical meteorological data has been made in performing assessments of air-quality impacts from a variety of sources. Terrain differences between the onsite location and the offsite data source may raise the question of representativeness of the meteorological data. The American Meteorological Society (AMS) (Hanna *et al.*, 1977), USEPA (1978) and USNRC (1972) have encouraged or indicated the value of using onsite data.

(d) *MST*. This method utilizes the SIGMA method during the day. However, at night a modification is made to account for horizontal meander. The MST method is summarized in Table 1.

During the night-time, the MST method uses both sigma theta and the wind speed to describe the atmospheric stability class. Night-time is defined in the usual manner (Turner, 1964) as 1 h before sunset to 1 h after sunrise. The night-time conversions (Table 1) were derived from the information concerning meander effects presented in the USNRC Regulatory Guide 1.145 (1979). The basis for the conversion is that horizontal wind meander becomes larger at night during a period of lower wind speed and stronger vertical thermal stability. This meander can make a significant contribution to the dispersion of effluents from a continuous point source as was demonstrated in tracer tests upon which Regulatory Guide 1.145 was based. According to the regulatory guide, wind meander may be large enough to increase horizontal dispersion by as much as a factor (at least) of six (USNRC, 1979) above that indicated by the standardized horizontal dispersion parameter (sigma y) curves (Gifford, 1979) which do not reflect the significant contribution to horizontal dispersion that the wind meander can give. The MST method, which is also consistent with the NWS-PT assumptions of stable and neutral conditions only during the night-time, is described in greater depth in Mitchell and Timbre (1979).

(e) *Stability distribution relationship*. Figure 1 illustrates the relationship (a composite for four sites) between these stability classification methods when applied to the same meteorological data. As reported earlier (Mitchell and Timbre, 1980) for the same data set as used in the study, several generalizations can be made about the frequency distributions:

NWS-PT yields more neutral (D) conditions than do the other methods.

DT/DZ yields the highest frequency of stable (E, F, G) conditions and SIGMA yields the lowest. NWS-PT yields a lower frequency of stable (E, F, G) conditions than does DT/DZ, and MST yields a frequency in between.

MST yields a frequency of unstable (A, B, C) conditions that is in between the yields for the other methods.

MST successfully compensates for night-time horizontal meander as evidenced by the shift of SIGMA to the MST distribution.

On an hour-by-hour basis, Mitchell and Timbre (1979) previously reported for an arbitrary (a composite of various sites) sample of data that during the night-time the within-one-stability class agreement of MST to DT/DZ was 81% as compared to a 50% agreement of SIGMA to DT/DZ. These per cent

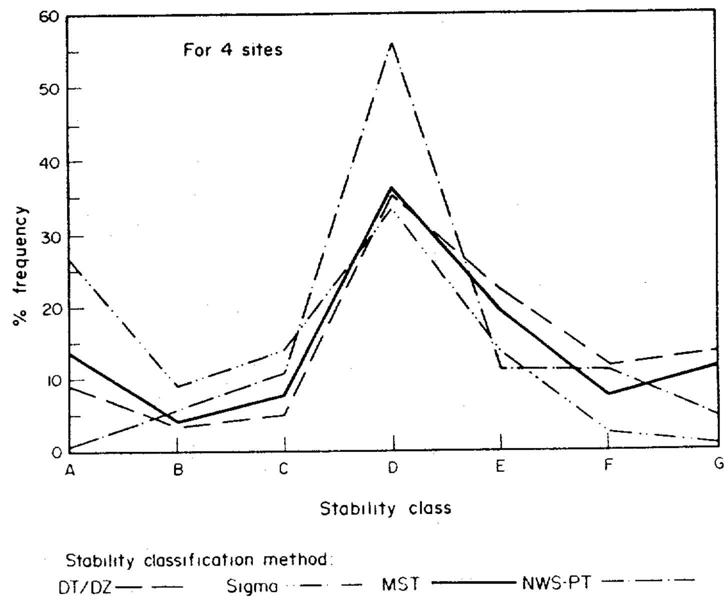

Fig. 1. Composite stability distribution.

agreements compare to those reported by DeMarrais (1978) for a gently-rolling Oklahoma site: between the hours of 1600 and 0800 (mostly night-time, but some day-time hours) the within-one-class agreement of SIGMA (defined slightly different from here) (26 m) to DT/DZ (44–26 m) was approximately 75%. For the same data sets, DeMarrais reported a 41% same-class agreement between the hours of 1600 and 0800 while Mitchell and Timbre reported a 25% same-class agreement at night-time for SIGMA to DT/DZ, with an improvement to 35% for MST to DT/DZ.

3. DISPERSION MODEL

Short-term dispersion estimates (χ/Q) were determined using the methods presented in Regulatory Guide 1.145 (USNRC, 1979). The χ/Q values applicable for releases of less than or equal to 2 h (nominally 1-h averages) were calculated using the joint frequency distributions of wind speed and wind direction by atmospheric stability class. Winds were determined at or adjusted to the 10-m level and stability class was based on one of the classification methods.

The χ/Q values for the ground-level releases were determined from the following equations:

$$\chi/Q = \frac{1}{\bar{u}(\pi\sigma_y\sigma_z + A/2)} \tag{1}$$

$$\chi/Q = \frac{1}{\bar{u}(3\pi\sigma_y\sigma_z)} \tag{2}$$

$$\chi/Q = \frac{1}{\bar{u}\pi\Sigma_y\sigma_z} \tag{3}$$

where

- χ/Q = the relative concentration at ground level, s m^{-3},
- $\bar{u}$ = the mean wind speed, m s^{-1},
- σ_y = the lateral plume spread, a function of atmospheric stability and distance, m,
- σ_z = the vertical plume spread, a function of atmospheric stability and distance, m,
- A = the smallest vertical plane, cross-sectional area of the building near which the effluent was released, m^2,
- Σ_y = lateral plume spread with meander and building wake effects, m, a function of atmospheric stability, wind speed, and distance. (For distances of 800 m or less, $\Sigma_y = M\sigma_y$, where M was determined from Fig. 3 in Regulatory Guide 1.145 (USNRC, 1979). For distances greater than 800 m, $\Sigma_y = (M-1)\sigma_y$ (800 m) $+ \sigma_y$.)

The χ/Q values were calculated using Equations (1), (2) and (3). The values from Equations (1) and (2) were compared, and the higher value was selected. This value was compared with the value from Equation (3) and the lower of these two was selected as the appropriate χ/Q value.

During unstable (A, B or C) atmospheric stability and/or wind speeds of 6 m s^{-1} or more, plume meander was not considered. The appropriate χ/Q value was the higher value calculated from Equation (1) or (2).

The model was run to represent a typical, effectively ground-level source of a 10-m release height within wake influences of a 20-m high structure (or stock pile or tailings) with a minimum vertical plane, cross-sectional area of $1000\,m^2$. Dispersion estimates were calculated for 16 wind sectors at 1000 and 3200 m from the source.

4. METEOROLOGICAL DATA BASE

Meteorological data from four different sites were used for the purpose of comparing the various stability classification methods. Different climatological and topographical characteristics were represented by the four sites: flat, coastal, desert and valley terrain. The data for each site type was monitored concurrently for one year. The data base used for this study was identical to that used in the assessment of the effect on annual average dispersion estimates (Mitchell and Timbre, 1980).

The sites representing each terrain type were selected for their availability of good-quality onsite data [conforming to USNRC (1972) guidance] and offsite data for a concurrent data period. All sites had good exposure for instrumentation.

At each of the onsite locations, wind speed, wind direction and sigma theta were measured at the 10-m level. Hourly speeds and directions were derived from at least one 15-min average h^{-1}. The sigma thetas were similarly derived with a 15-min sampling period. Sigma theta was computed either from instantaneous values at a frequency of more than once per second (with a nominal 10-s smoothing window), or by dividing the range of the wind direction during the sampling period by 6.0 (Markee, 1963). Vertical temperature gradients were measured between the lower level of 10 m and the upper level ranging from 35 to 60 m. The offsite information needed was a joint frequency distribution of wind speed and direction by atmospheric stability class determined by the NWS-PT method for a location that would typically be used to approximate onsite meteorology.

5. RESULTS

The stability distributions for each site and classification method are illustrated in Fig. 2. With regard to the valley site, the distributions by method differ more than in flatter terrain. In particular, the relatively high frequencies of large sigma thetas at the valley site may be attributable to terrain-induced turbulence and abundant night-time meander.

Throughout this paper, the term "concentration" is used to mean "relative concentration." The results of the calculations described in the previous section were assessed to determine the sector-dependent and sector-independent estimates of short-term (1-h average)

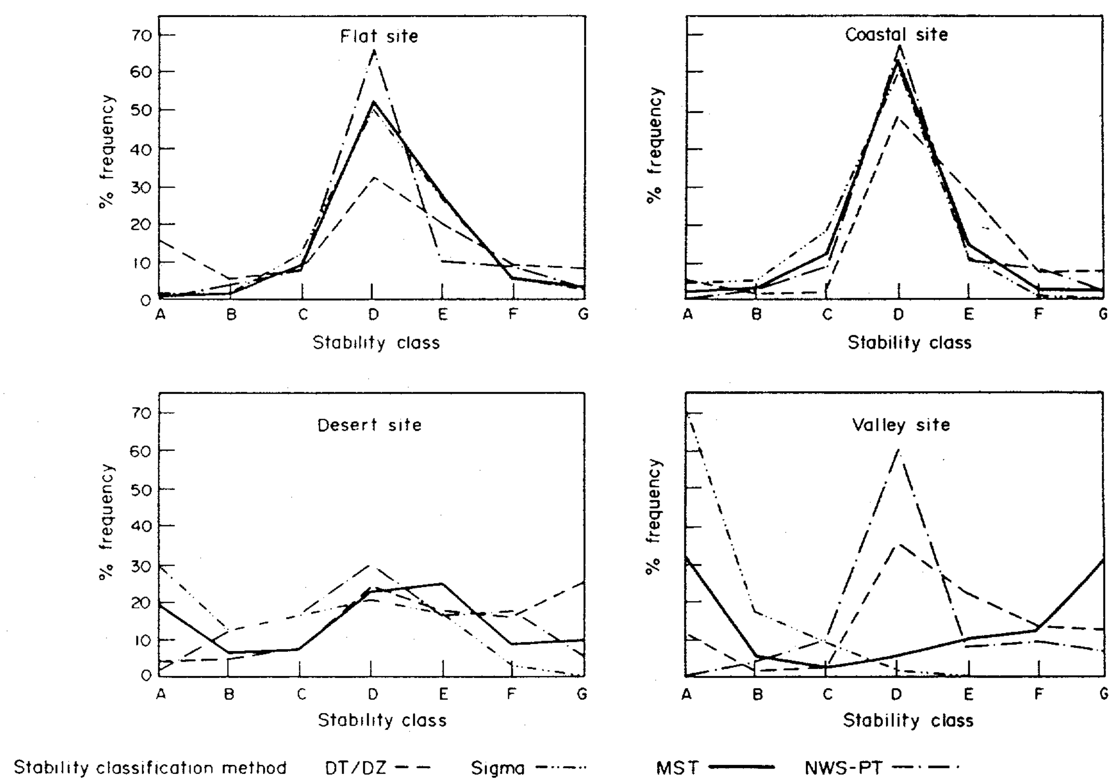

Fig. 2. Stability distribution by classification method. Annual stability distribution.

concentration as discussed in Regulatory Guide 1.145 (USNRC, 1979). The assessments were made at the radii of 1 and 3.2 km.

As described in Regulatory Guide 1.145 (USNRC, 1979), the values for each 22.5° directional sector were determined; the greatest concentration in the 16 sectors became the sector-dependent value. Also determined was the 5% overall concentration—that concentration which is equalled or exceeded 5% of the time—which is independent of sector. Under the guidance of Regulatory Guide 1.145, both of these values are normally reviewed to find the conservative short-term concentration representative for hypothetical accidents at a site. For most sites, the sector-dependent concentration is usually greater than the sector-independent concentration.

Sector-dependent concentrations

The results of the dispersion-modeling and the determination of the sector-dependent concentrations for each sector are illustrated in Fig. 3 for a downwind distance of 1000 m. Figure 4 (top) summarizes the peak concentration at 1000 m by site and stability classification method.

At a downwind distance of 1000 m, the maximum sector-dependent concentration is lower by MST than by DT/DZ by a ratio ranging from 0.57 to 0.94, as shown in Table 2. The concentration by NWS-PT is also lower than that by DT/DZ by a ratio ranging from 0.43 to 0.80. However, on the average, the concentration by MST was not only closer (mean deviation of 0.23) to that by DT/DZ than that by NWS-PT (mean deviation of 0.38), but the MST peak sectors were always within one sector agreement of those by DT/DZ whereas the NWS-PT peak sectors were not.

In comparison, Jubach *et al.* (1980), utilizing the same model and methodology discussed in R.G. 1.145, determined that the typical year-to-year variation of the maximum concentration at 1000 m varied by a ratio ranging from 0.76 to 0.96 of the highest-year concentrations. Therefore, it appears that in this study the concentration by MST varies only slightly more than that seen in normal year-to-year variations.

As part of a sensitivity study, Jubach *et al.* (1980) investigated the effect on the maximum-sector, sector-dependent concentration at 1 km of decreasing the frequency of stable conditions by ratios of 0.67 and 0.50. They concluded that such radical changes to the frequency of stable (to G; F and G; or E, F and G) conditions yielded only small changes in concentration for the model and methodology utilized—ratios ranging from 0.77 to 0.89. These changes are about the same

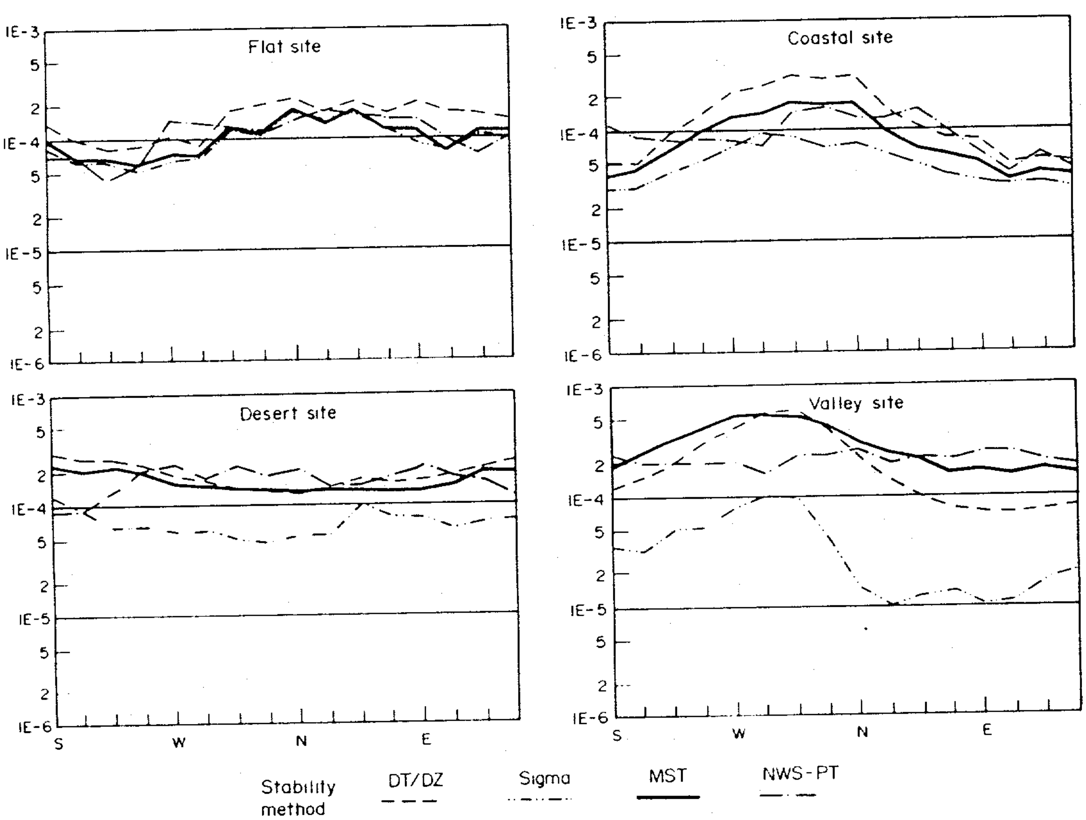

Fig. 3. Short-term sector-dependent concentrations by site and stability method. Relative concentration (5 m^{-3}) by direction at 1000 m.

Table 2. Sector-dependent concentrations and ratios at 1000 m. Short-term concentration ($s\ m^{-3}$) and (ratios) relative to value derived using the DT/DZ method

Site type	DT/DZ	SIGMA	MST	NWS-PT
	Stability classification used			
Flat	2.32E-4	1.72E-4	1.82E-4	1.76E-4
	(1.00)	(0.74)	(0.78)	(0.76)
Coastal	3.18E-4	9.21E-5	1.81E-4	1.57E-4
	(1.00)	(0.29)	(0.57)	(0.49)
Desert	2.92E-4	9.99E-5*	2.30E-4	2.34E-4*
	(1.00)	(0.34)	(0.79)	(0.80)
Valley	5.91E-4	1.02E-4	5.58E-4	2.56E-4*
	(1.00)	(0.17)	(0.94)	(0.43)
Mean deviation†	0.00	0.62	0.23	0.38

* Peak sector was more than one sector different from the peak sector identified using DT/DZ.

† Each entry determined by: $\dfrac{|\text{Concentration (DT/DZ)} - \text{Concentration (other)}|}{\text{Concentration (DT/DZ)}}$.

as those observed by them in year-to-year variations, where differences in wind direction and wind speed as well as stability affected the results.

In general, then, maximum-sector, sector-dependent concentrations calculated with stability classified by the MST method are nearly one-third lower than those calculated with stability classified by the DT/DZ method. They are lower by an amount equivalent to or slightly larger than variations usually attributed to year-to-year variability of meteorology or to the variation attributable to a halving of the frequency of stable conditions alone. However, relative to the ratio of the dispersion model results to tracer-study measurements for concentrations which indicates a level of conservatism by a factor of ten (Jubach *et al.*, 1980), the employment of MST stability classification method can yield reasonable conservative dispersion estimates for hypothetical accidents. The use of onsite data and the employment of the MST method, relative to that of offsite data and the NWS-PT method, yields better directional agreement with the DT/DZ results.

The results were similar, as shown in Table 3, at a distance of 3.2 km. However, the three methods other than DT/DZ yielded lower concentrations with respect to those determined with DT/DZ at 3.2 km than they did at 1 km.

Sector-independent concentrations

The results of the dispersion modeling and the determination of 5% concentrations are presented in Table 4. Figure 4 (bottom) graphically summarizes these by site and stability classification method at 1 km.

At a downwind distance of 1 km, the relative concentrations estimated with stability classified by the MST method and the NWS-PT method are usually somewhat lower than those estimated with stability classified by the DT/DZ method.

The ratio of concentrations by MST to those by DT/DZ ranged from 0.62 to 1.04 with a mean deviation of 0.23, whereas the ratio of concentrations by NWS-PT to those by DT/DZ ranged from 0.76 to 1.20 with a mean deviation of 0.21. Thus the variations between sites was approximately the same for MST and NWS-PT.

By comparison, in a previous study of short-term estimates for a downwind distance of 645 m, Woodward (1974) using a similar model (but without meander) determined that year-to-year variations in

Table 3. Sector-dependent concentrations and ratios at 3200 m. Short-term concentrations ($s\ m^{-3}$) and (ratios) relative to value derived using the DT/DZ method

Site type	DT/DZ	SIGMA	MST	NWS-PT
	Stability classification used			
Flat	7.86E-5	5.30E-5	5.63E-5	5.32E-5
	(1.00)	(0.67)	(0.72)	(0.68)
Coastal	1.16E-4	2.27E-5	5.74E-5	4.41E-5*
	(1.00)	(0.20)	(0.49)	(0.38)
Desert	1.06E-4	2.33E-5	8.40E-5	8.63E-5*
	(1.00)	(0.22)	(0.79)	(0.81)
Valley	2.16E-4	1.65E-5	2.05E-4	8.21E-5*
	(1.00)	(0.08)	(0.95)	(0.38)
Mean deviation†	0.00	0.71	0.26	0.44

* Peak sector was more than one sector different from the peak sector identified using DT/DZ.

† Each entry determined by: $\dfrac{|\text{Concentration (DT/DZ)} - \text{Concentration (other)}|}{\text{Concentration (DT/DZ)}}$.

Table 4. Sector-independent concentrations and ratios at 1000 m. Short-term 5% concentrations $(s\,m^{-3})$ and (ratios) relative to value derived using the DT/DZ method

Site type	DT/DZ	SIGMA	MST	NWS-PT
	Stability classification used			
Flat	2.13E-4	1.34E-4	1.42E-4	1.72E-4
	(1.00)	(0.63)	(0.67)	(0.81)
Coastal	2.05E-4	5.27E-5	1.27E-4	1.64E-4
	(1.00)	(0.26)	(0.62)	(0.80)
Desert	2.53E-4	8.47E-5	2.10E-4	3.04E-4
	(1.00)	(0.33)	(0.83)	(1.20)
Valley	4.35E-4	6.55E-5	4.52E-4	3.29E-4
	(1.00)	(0.15)	(1.04)	(0.76)
Mean deviation*	0.00	0.166	0.23	0.21

* Each entry determined by: $\dfrac{|\text{Concentration (DT/DZ)} - \text{Concentration (other)}|}{\text{Concentration (DT/DZ)}}$

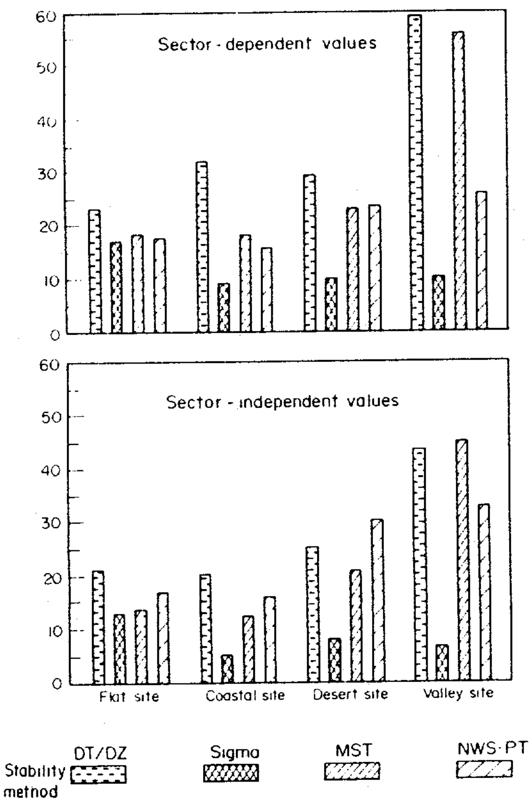

Fig. 4. Comparison of short-term concentration magnitudes. Relative concentrations $(10^{-5}\,s\,m^{-3})$ at 1000 m by stability method and site type.

the ratios between years ranged from 0.72 to 0.98 relative to the year with the highest concentrations. These variations were attributed to varying meteorology. Also by comparison, this variation is about the same as that noted by Jubach (1980) for the sector-dependent variations (0.76 to 0.96) from year-to-year. Thus the difference in dispersion estimates (as a result of stability by MST or NWS-PT vs. those of stability by DT/DZ) is approximately the same magnitude as that expected in year-to-year differences when stability by DT/DZ alone is used.

At a distance of 3.2 km, the results were similar, as shown in Table 5. However, the three methods other than DT/DZ yielded lower concentrations with respect to those determined with DT/DZ at 3.2 km than they did at 1 km.

6. DISCUSSION

The results indicate that the use of sigma theta data to classify stability by the SIGMA method in a straight-line dispersion model yields short-term dispersion estimates that are low and variable relative to the commonly-used estimates based upon stability classified by DT/DZ. Similar results were noted for annual-average dispersion estimates (Mitchell and Timbre, 1980).

However, use of sigma theta data to classify stability by the MST method offers an alternative method to make reasonable short-term dispersion estimates. Similar to estimates made by the NWS-PT method (typically employing offsite data), the short-term dispersion estimates are generally only slightly lower than those made using stability classified by DT/DZ. And the variations (for MST and NWS-PT) in dispersion estimates are of the same magnitude as year-to-year variations in dispersion estimates for DT/DZ data input.

The use of onsite sigma theta data and the MST method has the advantage over that of the offsite data and NWS-PT method in that the former better identifies the peak sector for the sector-dependent short-term estimates. Similarly in the previous study (Mitchell and Timbre, 1980) of long-term (annual-average) dispersion estimates, the use of offsite data and the NWS-PT method did not consistently identify the sectors with peak annual-average.

The reason for the differences between short-term dispersion estimates determined with stability by the DT/DZ method (onsite data) and by the NWS-PT method (offsite data) is attributed primarily to the differences in the classification system themselves rather than to difference in the data sets. As shown in

Table 5. Sector-independent concentrations and ratios at 3200 m. Short-term 5 % concentrations (s m^{-3}) and (ratios) relative to value derived using the DT/DZ method

	Stability classification used			
Site type	DT/DZ	SIGMA	MST	NWS-PT
Flat	7.16E-5	3.79E-5	4.06E-5	4.77E-5
	(1.00)	(0.53)	(0.57)	(0.67)
Coastal	7.06E-5	1.41E-5	3.67E-5	4.42E-5
	(1.00)	(0.20)	(0.52)	(0.63)
Desert	8.64E-5	1.87E-5	7.52E-5	9.74E-5
	(1.00)	(0.22)	(0.87)	(1.13)
Valley	1.54E-4	8.78E-6	1.64E-4	1.13E-4
	(1.00)	(0.06)	(1.06)	(0.73)
Mean deviation*	0.00	0.75	0.28	0.28

$$* \text{ Each entry determined by: } \frac{|\text{Concentration (DT/DZ)} - \text{Concentration (other)}|}{\text{Concentration (DT/DZ)}}.$$

Fig. 5 in a graphic portrayal of differences in concentrations, frequency of calms, average wind speed, and the frequency of stable conditions as expressed by ratios, the frequency of stable conditions appears to be the most important and to a lesser extent, the frequency of calms.

In terms of application to practical problems involving low-level sources the following suggestions are offered. At the phase of a siting study or impact analysis where only the magnitude of short-term or long-term dispersion estimates are needed, the use of historical airport-type data and the use of the NWS-PT method to classify the atmospheric stability is reasonable. However, at a study phase where a particular source, site and/or receptors are involved, and short-term or long-term dispersion estimates are needed, then the use of onsite wind data (from a properly selected location) and the MST method to classify atmospheric stability is reasonable.

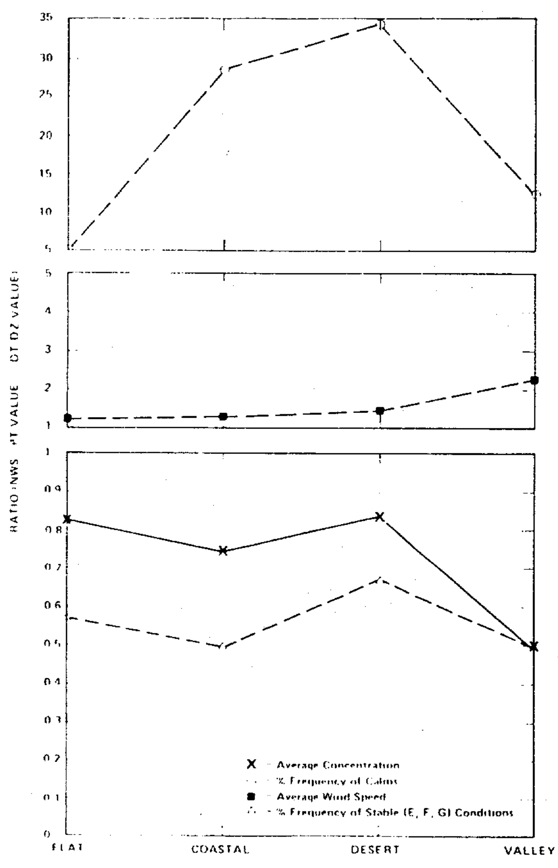

Fig. 5. Ratio analysis for all-sector average concentration.

Of course, in the latter case, the use of vertical temperature gradient data from an onsite tower and the employment of the DT/DZ method to classify stability could be used as well. An advantage, however, of the MST approach would be in the use of a smaller tower, less instrumentation, and reduced maintenance/calibration, since only a 10-m wind system would be needed. In some instances, the use of DT/DZ is prescribed: nevertheless, the use of MST can be considered for supplemental or realtime backup data sources. Particularly with the evolving USNRC guidance to develop a good emergency response capability at nuclear power plants, employment of the MST approach may be useful. On a study of short-term concentrations for selected hours, Lague *et al.* (1980) found the MST method to yield realistic results for dispersion of a plume in a coastal environment.

7. CONCLUSIONS

Atmospheric stability (determined by four methods) of four terrain sites are compared. The MST method for classifying atmospheric stability yields a stability distribution similar to those produced with the commonly used DT/DZ and NWS-PT methods. Through the use of a short-term, Gaussian dispersion model, it is shown that the MST method yields dispersion estimates similar to those obtained by DT/DZ and NWS-PT methods for an effectively ground-level source.

The MST method yields short-term dispersion estimates that vary in ratio to those yielded by the DT/DZ method from 0.57 to 1.04. This compares to estimates yielded by the NWS-PT method in ratio to those yielded by the DT/DZ method from 0.43 to 20. And for annual-average concentrations as well (Mitchell and Timbre, 1980), the MST method usually yields values which are lower (by 20%) than those yielded by DT/DZ but which are higher than those yielded by NWS-PT.

The differences in short-term dispersion estimates derived by the MST and NWS-PT stability classifications vs. those by DT/DZ are of the same magnitude as year-to-year variations for those by DT/DZ alone.

With respect to direction, however, the MST method yields the same peak-sector (sector dependent) direction (within one sector) as that indicated by the DT/DZ method, while the NWS-PT method does not in all instances. The inability of the NWS-PT data site to consistently and properly identify the peak sector (both for long-term and short-term estimates) is attributed primarily to the fact that offsite National Weather Service data are not always fully representative of the sites.

The results of this study along with previous ones suggest, where the magnitude and direction of dispersion estimates are required for a particular site, that the use of onsite wind data and the MST method to classify atmospheric stability is a reasonable alternative approach. This applies to near-ground level source applications where meteorology is needed either for developing a dispersion climatology or for meeting realtime data reporting requirements.

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